Memorandum 6 May 2016

From: Chris Stachelski, Regional Observational Program Leader
To: Thomas R. Karl, Director, NCEI
Subject: SCEC Decision: New 24 Hour Snowfall Record For North Carolina

On 9 February 2016, the State Climate Extremes Committee (SCEC) began exchanging e-mails to evaluate the validity of a 24-hour snowfall value for the State of North Carolina. A total of 41 inches of snow was reported for the 24-hour period ending at 7:00 AM EST on January 23, 2016 by the cooperative weather station located at Mt. Mitchell, North Carolina (COOP Identifier 31-5923). The SCEC examined several factors surrounding this value including the observed liquid precipitation (water equivalent of the snow) and the snow depth as well as the equipment at the cooperative weather station. The SCEC voted unanimously (0-5) against accepting the 41 inches of snow as the 24-hour all-time snow record for North Carolina. In addition, the team decided to accept adjusted values for liquid precipitation, snow and snow depth for the event on January 23, 2016 and adjusted snow depth values from January 24-31, 2016. **I request that the current 36 inch record, reported on March 13, 1993, also at Mount Mitchell stand as the current record for 24-hour snow for the State of North Carolina.**

Background and Metadata

Mount Mitchell, North Carolina is the highest peak in the continental United States east of the Mississippi River at an elevation of 6,366 feet. A cooperative weather station there was first established in January 1915 as 'Mount Mitchell" and remained there until September 1953 under the COOP Identifier 31-5921. In October 1953, the site was moved and became known as "Mount Mitchell 2 SSW" and operated through August 1965 under the COOP Identifier 31-5922. The current site of "Mt. Mitchell" operating under COOP Identifier 31-5923 started taking observations on November 17, 1988. It is located at 35.7586, -82.2711 at an elevation of 6240 feet. The observations are taken by the staff at Mount Mitchell State Park at the present at 7:00 AM EST and represent a 24 hour period. Temperature, precipitation, snow and snow depth are collected by the observers as part of their observation.

The equipment located here for both precipitation and snow measuring presents some challenges and it was recommended to the National Weather Service office in Greer, SC who maintains the site by Eastern Region Headquarters that some changes be made and documented. The precipitation gauge used during this event was a 4 inch plastic gauge that became buried in the snow. It was recommended the site be switched back to an eight inch standard rain gauge. Additionally, the current station metadata has nothing on file documenting any snow measuring equipment at the location. The observing site is located on a relatively flat area on the edge of a slope with some short trees nearby.

The current Mt. Mitchell cooperative observation site. Photo provided by the National Weather Service in Greer, SC.

Meteorological/Climatological Feasibility

The 24-hour snow value of 41 inches reported here along with the initial peak snow depth of 63 inches became very suspect as accurate due to being the highest values observed from any official weather station in the eastern United States from the Blizzard of January 2016. In addition, several other recent large snowstorms at Mt. Mitchell have also been suspect due to larger totals being measured compared to nearby stations. Although the station is at an extreme location relative to other locales, the skepticism in the observation was based on:

- Inconsistent/unusual snow-to-liquid ratios on the single day in question, and to some extent, overall
- Unusual patterns in the accumulation of new snow, suggesting drifts were a factor,
- Although heavy snow can be a meso/microscale influenced event, there is a lack of strongly supporting evidence from neighboring stations
- The testimony of the Appalachian State professor who has noted some issues in the recent past and provided much of the detail associated with some of the above same concerns the SCEC had.
- Photos provided after the event of the snow tend to indicate that the snow depth values seem to reflect values less than indicated as snow depth.
- Concern over blowing and drifting of snow

Photos of the snow taken by the park staff at Mount Mitchell. The second photo shows the guardrail (which is not visible) that is 30-34 inches high.

Event Synopsis and Determined Values

Rounds of heavy snow fell atop Mount Mitchell from 21-24 January 2016. The initially reported storm total snowfall from the COOP observer at Mount Mitchell State Park (31-5923) was 65.5 inches. A maximum depth of 60 inches was reported during the morning of 24 January. In addition, a 24 hour snowfall of 41 inches was reported on the morning of 23 January. After it was determined there were values during the storm that were not meteorologically possible, it was agreed on by the SCEC that WFO Greer, SC (GSP) provide estimates to replace some of the values observed during this event to provide a complete and better quality climate record.

For the period 21-22 January, it was eventually determined that values on the archived WxCoder generated B-91, need to revert to the amounts originally entered by the observers on site. These are the daily snow values of 8.5 and 11.0 inches respectively with the corresponding snow depth values of 9 and 16 inches. Respective snow liquid ratios (SLRs) were 15:1 and 17:1, generally within Mount Mitchell's historical range of departure from the observed average SLR across the North Carolina Mountains for any given snow event.

For 23 January, all originally reported liquid equivalent and snowfall/depth measurements are considered too high. It is difficult to figure out how a liquid equivalent was even measured, since the 4 inch plastic raingage should have been completely buried under drifted snow. Hence, the original liquid equivalent was reduced about 25% to 1.56 inches, based on regional reports. A 41 inch snowfall would result in an SLR of 26:1. Area upper air soundings that day exhibited a strong warm nose close to freezing which would have made it very difficult to achieve SLRs above 15:1. In fact, regional SLRs that day averaged 9:1 or 10:1 across the mountains. With a generous 13:1 determined for Mount Mitchell that day, a revised snowfall of 21 inches was determined, with an approximate depth now standing at 33 inches.

Progressively colder northwest flow snow developed into the morning of 24 January, so the originally entered daily snow will remain unchanged for that day, although an estimated lower snow depth of 36 inches was needed. The snow depth entries for the rest of the month reflect gradual compacting and melting of the said 36 inch snow depth.

Evaluation of Existing Record

The current 36 inch value at Mt. Mitchell, NC was measured on March 13, 1993 during the "Storm of the Century". This storm produced significant and crippling snowfall along the entire spine of the Appalachians from North Georgia to New York state. This record is well supported by surrounding observations recorded during that event.

Conclusion

The SCEC voted unanimously (0-5) against accepting the 41 inches of snow as the 24-hour all-time snow record for North Carolina. In addition, the team decided to accept adjusted values for liquid precipitation, snow and snow depth for the event on January 23, 2016 and adjusted snow depth values from January 24-31, 2016. **It is request that the current 36 inch record, reported on March 13, 1993, also at Mount Mitchell stand as the current record for 24-hour snow for the State of North Carolina.**

Acknowledgements

Thanks to both the staff at the National Weather Service in Greer, SC and the North Carolina State Climatologist Office for their insight into the local meteorology as well as previous events at this location and for providing images to the SCEC.

State Climate Extremes Committee Members:
Chris Stachelski, Regional Observation Program Leader, Eastern Region Headquarters, NWS (Voting)
Christopher Horne, Observational Program Leader, National Weather Service, Greer, SC
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Deke Arndt, National Centers for Environmental Information (Voting)
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